

CLAIMS

What is claimed is:

- 1 1. A method comprising:
2 performing a first elemental search over a highest-order elementary
3 modulation on a received signal vector that includes multiple elements, wherein the
4 first elemental search is performed within a first search space and produces an
5 identified vector of elementary modulation symbols;
6 transforming the received signal vector to a new origin that corresponds to
7 the identified vector, resulting in a transformed, received signal vector; and
8 performing a subsequent elemental search on the transformed, received
9 signal vector, wherein the subsequent elemental search is performed within a
10 reduced search space defined by the identified vector, and wherein the subsequent
11 elemental search produces a next identified vector of elementary modulation
12 symbols.
- 1 2. The method of claim 1, wherein the received signal vector is modulated
2 using quadrature amplitude modulation, and quadrature phase shift keying is an
3 elementary modulation.
- 1 3. The method of claim 1, wherein the received signal vector is modulated
2 using pulse amplitude modulation, and binary phase shift keying is an elementary
3 modulation.
- 1 4. A method comprising:
2 performing a first quadrature phase shift keying (QPSK) search on a
3 received signal vector that includes multiple elements, wherein the first QPSK
4 search is performed within a first search space and produces an identified QPSK
5 vector;

6 transforming the received signal vector to a new origin that corresponds to
7 the identified QPSK vector, resulting in a transformed, received signal vector; and
8 performing a subsequent QPSK search on the transformed, received signal
9 vector, wherein the subsequent QPSK search is performed within a reduced search
10 space defined by the identified QPSK vector, and wherein the subsequent QPSK
11 search produces a next identified QPSK vector.

1 5. The method of claim 4, further comprising:
2 producing the received signal vector, wherein each of the multiple elements
3 corresponds to a signal received by one of multiple receive antennas of a multiple-
4 input multiple-output receive antenna array.

1 6. The method of claim 4, further comprising:
2 scaling the transformed, received signal vector, prior to performing the
3 subsequent QPSK search.

1 7. The method of claim 4, further comprising:
2 until the subsequent QPSK search results in a next identified QPSK vector
3 that corresponds to a constellation point,
4 repeating transforming the transformed, received signal vector; and
5 repeating performing the subsequent QPSK search.

1 8. The method of claim 4, further comprising:
2 incorporating a tree-searching algorithm into either or both the first QPSK
3 search and the subsequent QPSK search to produce multiple identified QPSK
4 vectors that are used to define the reduced search space.

1 9. The method of claim 8, wherein incorporating the tree-searching algorithm
2 comprises:
3 incorporating an M-algorithm tree search into a QPSK search.

- 1 10. The method of claim 8, wherein incorporating the tree-searching algorithm
2 comprises:
3 incorporating a T-algorithm tree search into a QPSK search.
- 1 11. The method of claim 4, further comprising:
2 producing search results that include at least one soft decision for use by a
3 decoder.
- 1 12. The method of claim 11, wherein producing the search results comprises:
2 producing the at least one soft decision as a set of log-likelihood ratios or
3 approximations of log-likelihood ratios.
- 1 13. The method of claim 4, further comprising:
2 producing search results that include de-mapped bit values corresponding to
3 a QPSK vector identified as a result of a lowest-level search.
- 1 14. A method comprising:
2 performing a first quadrature phase shift keying (QPSK) search on a
3 received signal vector, \mathbf{Y} , which includes multiple elements, wherein the first QPSK
4 search is performed within a first search space and produces an identified QPSK
5 vector; and
6 until a reduced search space corresponds to a QPSK constellation,
7 canceling higher-order interference based on the identified QPSK
8 vector and scaling the multiple elements within the received signal vector
9 according to $\tilde{\mathbf{Y}}_k = \frac{1}{2}(\tilde{\mathbf{Y}}_{k-1} - \hat{\mathbf{x}}_{k-1})$, where $\tilde{\mathbf{Y}}_k$ is a scaled version of the
10 received signal vector at search level k , and $\hat{\mathbf{x}}_k$ is a QPSK vector at search
11 level k , and

12 performing a level- k QPSK search according to
13 $\hat{\mathbf{x}}_k = \arg \min_{\text{QPSK vectors } \mathbf{x}} \|\tilde{\mathbf{Y}}_k - \mathbf{H}\mathbf{x}\|^2$, where \mathbf{H} is a channel transfer matrix, and \mathbf{x}
14 is a transmit signal vector.

1 15. The method of claim 14, further comprising:
2 incorporating a tree-searching algorithm into either or both the first QPSK
3 search and the level- k QPSK search to produce multiple identified QPSK vectors
4 that are used to define the reduced search space.

1 16. The method of claim 14, further comprising:
2 producing search results that include at least one soft decision for use by a
3 decoder.

1 17. The method of claim 16, wherein producing the search results comprises:
2 producing the at least one soft decision as a set of log-likelihood ratios or
3 approximations of log-likelihood ratios.

1 18. The method of claim 14, further comprising:
2 producing search results that include de-mapped bit values corresponding to
3 a QPSK vector identified as a result of a lowest-level search.

1 19. A computer-readable medium having program instructions stored thereon to
2 perform a method which, when executed within a multiple-input multiple-output
3 device, results in:

4 performing a first quadrature phase shift keying (QPSK) search on a
5 received signal vector that includes multiple elements, wherein the first QPSK
6 search is performed within a first search space and produces an identified QPSK
7 vector;
8 transforming the received signal vector to a new origin that corresponds to
9 the identified QPSK vector, resulting in a transformed, received signal vector; and

10 performing a subsequent QPSK search on the transformed, received signal
11 vector, wherein the subsequent QPSK search is performed within a reduced search
12 space defined by the identified QPSK vector, and wherein the subsequent QPSK
13 search produces a next identified QPSK vector.

1 20. The computer-readable medium of claim 19, wherein performing the method
2 further results in:

3 incorporating a tree-searching algorithm into either or both the first QPSK
4 search and the subsequent QPSK search to produce multiple identified QPSK
5 vectors that are used to define the reduced search space.

1 21. The computer-readable medium of claim 19, wherein performing the method
2 further results in:

3 producing search results that include at least one soft decision for use by a
4 decoder.

1 22. The computer-readable medium of claim 19, wherein performing the method
2 further results in:

3 producing search results that include de-mapped bit values corresponding to
4 a QPSK vector identified as a result of a lowest-level search.

1 23. An apparatus comprising:

2 multiple receive antennas operable to receive multiple received signals; and
3 a symbol-processing element, operable to

4 perform a first quadrature phase shift keying (QPSK) search on a
5 received signal vector that includes multiple elements corresponding to the
6 multiple received signals, wherein the first QPSK search is performed within
7 a first search space and produces an identified QPSK vector;

8 transform the received signal vector to a new origin that corresponds
9 to the identified QPSK vector, resulting in a transformed, received signal
10 vector; and

11 perform a subsequent QPSK search on the transformed, received
12 signal vector, wherein the subsequent QPSK search is performed within a
13 reduced search space defined by the identified QPSK vector, and wherein
14 the subsequent QPSK search produces a next identified QPSK vector.

1 24. The apparatus of claim 23, wherein the symbol-processing element is further
2 operable to:

3 incorporate a tree-searching algorithm into either or both the first QPSK
4 search and the subsequent QPSK search to produce multiple identified QPSK
5 vectors that are used to define the reduced search space.

1 25. The apparatus of claim 23, wherein the symbol-processing element is further
2 operable to:

3 produce search results that include at least one soft decision for use by a
4 decoder.

1 26. The apparatus of claim 23, wherein the symbol-processing element is further
2 operable to:

3 produce search results that include de-mapped bit values corresponding to a
4 QPSK vector identified as a result of a lowest-level search.

1 27. A multiple-input multiple-output communication device, comprising:
2 multiple receive antennas operable to receive multiple received signals; and
3 a symbol-processing element, operable to

4 perform a first quadrature phase shift keying (QPSK) search on a
5 received signal vector that includes multiple elements corresponding to the
6 multiple received signals, wherein the first QPSK search is performed within
7 a first search space and produces an identified QPSK vector;
8 transform the received signal vector to a new origin that corresponds
9 to the identified QPSK vector, resulting in a transformed, received signal
10 vector; and

11 perform a subsequent QPSK search on the transformed, received
12 signal vector, wherein the subsequent QPSK search is performed within a
13 reduced search space defined by the identified QPSK vector, and wherein
14 the subsequent QPSK search produces a next identified QPSK vector.

1 28. The multiple-input multiple-output communication device of claim 27,
2 wherein the symbol-processing element is further operable to:
3 incorporate a tree-searching algorithm into either or both the first QPSK
4 search and the subsequent QPSK search to produce multiple identified QPSK
5 vectors that are used to define the reduced search space.

1 29. The multiple-input multiple-output communication device of claim 27,
2 wherein the symbol-processing element is further operable to:
3 produce search results that include at least one soft decision for use by a
4 decoder.

1 30. The multiple-input multiple-output communication device of claim 27,
2 wherein the symbol-processing element is further operable to:
3 produce search results that include de-mapped bit values corresponding to a
4 QPSK vector identified as a result of a lowest-level search.